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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/613,235	07/03/2003	Kyle K. Kirby	400.231US01	4763

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EXAMINER

SMOOT, STEPHEN W

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 07/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/613,235

Applicant(s)

KIRBY, KYLE K.

Examiner

Stephen W. Smoot

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 12-16 and 22-25 is/are allowed.
- 6) ☒ Claim(s) 1-11, 17-21 and 26-29 is/are rejected.
- 7) ☒ Claim(s) 30-34 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 October 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>10-14-03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office action is in response to application papers filed on 03 July 2003.

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference characters mentioned in the description:

162 in Fig. 5 (see paragraph [0027]); and

700 in Fig. 7 (see paragraph [0029]).

Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character not mentioned in the description:
- 600 in Fig. 7.

Corrected drawing sheets, or amendment to the specification to add the reference character in the description, are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: Method for Forming Via Plugs Using an Aerosol Stream of Particles to Deposit Conductive Material.

Claim Objections

4. Claims 7-8, 21, 30-34 are objected to because of the following informalities:

In claim 7, line 2, change "steam" to --stream-- for proper antecedence to the aerosol stream of claim 1, line 2;

In claim 8, line 2, change "steam" to --stream-- for proper antecedence to the aerosol stream of line 1;

In claim 21, line 2, change "steam" to --stream-- for proper antecedence to the aerosol stream of line 1;

In claim 30, line 7, change "via form" to --via to form-- to correct grammar; and
Claims 31-34 are objected to because they depend on claim 30.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-3, 5-11, 17-21 are rejected under 35 U.S.C. 102(b) as being anticipated by Miyata et al. (US 5,529,634).

Referring to Figs. 11A-11C and column 11, line 1 to column 13, line 42, Miyata et al. disclose a method for filling a contact hole (3a) to a semiconductor substrate (1) that is formed in an overlying insulating layer (3) with fine metal particles (13). The filled contact hole (3a) can be used to connect wiring layers to each other (see column 11, lines 64-67) and, more generally, the fine metal particles (13) are used in forming films that are applied to a semiconductor substrate on which an integrated circuit is formed (also see column 13, lines 43-50). The metal can be silver and the fine metal particles (13) are directly sprayed into the contact hole using inert gas (i.e. an aerosol comprising the fine silver particles suspended in the inert gas). The fine metal particles (13) are sprayed into the chamber (B) through a feed pipe (27 in Fig. 3) equipped with a small diameter nozzle (12 in Fig. 3) (also see column 6, lines 43-52). The fine metal particles (13) have a grain size that ranges from 100 to 1000 angstroms (i.e. 10 to 100 nm) (also see column 6, lines 30-34). The semiconductor substrate is placed in a chamber (B in Fig. 3) that includes a heater (28 in Fig.3) (also see column 6, lines 52-55). Heating the substrate improves adhesion of the deposited fine metal particles (see column 11, lines 61-63). The fine metal particles (13) are deposited from the bottom of the contact hole (3a) as shown in Fig. 11B, but may alternatively be deposited on the side wall of the contact hole (3a) by controlling the spray angle (see column 11, lines 24-28, 43-46).

These are all of the limitations set forth in claims 1-3, 5-11, 17-21 of the applicant's invention.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miyata et al. (US 5,529,634) as applied to claim 1 above, and further in view of Miller et al. (US 6,251,488 B1) – from applicant's IDS).

As shown above, Miyata et al. anticipate claim 1 of the applicant's invention. However, Miyata et al. lack the further limitation to claim 1 set forth in claim 4 of the applicant's invention, which is to pass the aerosol stream through a laser beam before depositing the conductive material. Miller et al. teach a method of depositing a feedstock on a substrate that includes passing the feedstock through a laser beam to make the feedstock depositable (see column 4, lines 51-62). The feedstock can be an aerosol (see column 5, lines 39-58) and may include a conductive material like silver, copper, or gold (see column 7, lines 45-59).

Therefore it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the teachings of Miyata et al. by using a laser beam as taught by Miller et al. to heat the fine metal particle spray of Miyata et al. prior

to depositing it on the substrate. Miyata et al. recognize that heating the fine metal particles prior to deposition by heating the nozzle or feed pipe has the advantage of improved adhesion of the deposited metal film (see Miyata et al., column 11, lines 46-52) and the laser beam of Miller et al. would be another way to heat the fine metal particles (see Miller et al., column 7, lines 45-48).

9. Claims 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Miyata et al. (US 5,529,634) in view of Lee (US 6,355,533 B2) and Noguchi (US 5,343,434).

Referring to Figs. 11A-11C and column 11, line 1 to column 13, line 42, Miyata et al. disclose a method for filling a contact hole (3a) to a semiconductor substrate (1) that is formed in an overlying insulating layer (3) with fine metal particles (13). The filled contact hole (3a) can be used to connect wiring layers to each other (see column 11, lines 64-67) and, more generally, the fine metal particles (13) are used in forming films that are applied to a semiconductor substrate on which an integrated circuit is formed (also see column 13, lines 43-50). The metal can be silver and the fine metal particles (13) are directly sprayed into the contact hole using inert gas (i.e. an aerosol comprising the fine silver particles suspended in the inert gas). The fine metal particles (13) are sprayed into the chamber (B) through a feed pipe (27 in Fig. 3) equipped with a small diameter nozzle (12 in Fig. 3) (also see column 6, lines 43-52). The semiconductor substrate is placed in a chamber (B in Fig. 3) that includes a heater (28 in Fig.3) (also see column 6, lines 52-55). Heating the substrate improves adhesion of the deposited

fine metal particles (see column 11, lines 61-63). These are limitations set forth in claims 26-29 of the applicant's invention.

However, Miyata et al. do not teach or suggest forming a via plug in a memory circuit, which is a limitation of claim 26. Further, Miyata et al. do not teach or suggest a memory circuit that comprises an array of memory cells connected to column and row address decoders and a sensing circuit, which are also limitations of claim 26.

Lee teaches a method of forming a contact plug in a memory cell area (see column 2, lines 12-48). Noguchi teaches a memory circuit that includes a memory cell array, an X decoder for selecting a row of the array, a Y decoder for selecting a column of the array, and a sensing circuit for reading memory cell data (see column 5, lines 27-50).

Therefore it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Miyata et al., Lee, and Noguchi in order to fill vias in a memory cell array using the fine metal spraying method taught by Miyata et al. Lee shows that contact plugs are use in memory cells for making electrical contact to source/drain regions (see 234 in Fig. 2F). Noguchi shows that memory circuits include column and row address decoders and a sensing circuit in order to read data from a corresponding memory cell array (see column 5, lines 27-50).

Allowable Subject Matter

10. Claims 12-16, 22-25 are allowed.

11. Claims 30-34 would be allowable if rewritten or amended to overcome the objection to claim 30 set forth in this Office action.

12. The following is a statement of reasons for the indication of allowable subject matter:

- Claims 12-16 are allowed because the prior art of record does not teach or suggest, in combination with the other claim limitations, a method of forming a via plug that includes forming a seed layer on a sidewall of a via from an aerosol stream of particles of a first conductive material combined with plating the seed layer with a second conductive material;
- Claims 22-25 are allowed because the prior art of record does not teach or suggest, in combination with the other claim limitations, a method of forming an integrated circuit device that includes forming a seed layer on a sidewall of a via from an aerosol stream of particles of a first conductive material combined with plating the seed layer with a second conductive material to form a via plug; and
- Claims 30-34 would be allowable because the prior art of record does not teach or suggest, in combination with the other claim limitations, a method of

manufacturing an integrated memory circuit that includes forming a seed layer on a sidewall of a via from an aerosol stream of particles of a first conductive material combined with plating the seed layer with a second conductive material to form a via plug in the memory circuit.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Yamaguchi et al., Sakata et al., and Nemoto teach methods of filling openings in integrated circuits that feature spraying metal particles into the opening.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen W. Smoot whose telephone number is 571-272-1698. The examiner can normally be reached on M-F (8:00am to 4:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2813

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SWS

Stephen W. Smoot
Patent Examiner
Art Unit 2813